

## **A survey to detect first sdB Planetary Transits**

Roberto Silvotti

INAF

To date nothing is known about the final (WD) configuration of ~97% of planetary systems! While not a single bona-fide planet has been identified orbiting an isolated WD (Fulton+2014, ApJ 796, 114), it is now widely accepted that the dusty and/or gaseous disks that we see within one solar radius around many WDs are produced by the tidal disruption of asteroids (Farihi+2010, MNRAS 404, 2123). An increasing fraction of WDs ( $\geq 27\%$ ) show a metal enrichment due to the fall into the WD atmosphere of ancient planetary material (Koester+2014, A&A 566, 34), whose chemical composition is similar to that seen in different Solar-system meteorites (Gansicke+2012, MNRAS 424, 333).

Theory predicts a gap in the final distribution of orbital periods, due to the opposite effects of stellar mass loss (planets pushed outwards) and tidal interactions (planets pushed inwards) during the RGB and the AGB phases (Nordhaus & Spiegel 2013, MNRAS 432, 500). While Gaia will discover WD planets at several AUs from their host stars, those external to the period gap (Silvotti+2014, arXiv1412.3307), this proposal aims to study the inner boundary of the period gap. Substellar companions to sdB stars offer a unique opportunity to disentangle the effects of the RG expansion alone (while WD planets are affected also by AGB expansion, thermal pulses and PN ejection, Mustill & Villaver 2012, ApJ 761, 121; Villaver+2014, ApJ 794, 3), and they represent the natural 1st step to study the post-RGB evolution of planetary systems and their final architecture. Star/planet interactions during the RGB may be responsible for the stellar envelope ejection leading to the formation of a single sdB star (Soker 1998, AJ 116, 1308; Han+2012, PASP Conf.Ser. 452, 3).

Among 18 planet/BD candidates around sdB stars (Silvotti+2014, ASP Conf.Ser. 481, 13), 2 planetary systems were detected by Kepler measuring the photometric modulation due to reflection/re-emission of the star light (Charpinet+2011, Nature 480, 496; Silvotti+2014, A&A 570, 130). Given that only 15 sdBs were observed by Kepler for enough time to detect tiny photometric variations of 20-50 ppm, we can assume that 2/15 of sdBs have Earth-size bodies in tight orbits at  $\sim 0.005$  AU from the star. With a geometric transit probability of 0.2 ( $R_p < R_{sdB}$ ,  $R_{sdB} = 0.001$  AU), the prob. to see a transit is about 0.027, i.e., in average, we need to observe  $\sim 40$  sdB stars to see one transit. An even higher transit prob. is obtained for the more massive companions detected through RVs: Geier+2012 (ASP Conf.Ser. 452, 153) found that 16% of their sample of 27 single-lined sdBs do show small RV variations compatible with massive substellar companions. Here the geom. transit probability at 0.005 AU is  $\sim 0.28$  ( $R_p = 0.9 R_{Jup}$ ) so that, in average, 1 sdB out of  $\sim 22$  should show transits and secondary eclipses.

The main goal of this proposal is to detect sdB planetary transits and measure for the 1st time sdB planet radii by targetting in SC  $\sim 50$  sdB/sdO stars in the 9 fields of K2. SC is required as the typical transit duration for a close planet with  $6h < P_{orb} < 24h$  is 15 to 40 min. The transit depth may vary between 25% (Jovian radius) down to 0.2% (Earth radius). Given the high number of transits in a  $\sim 75$  days observation, K2 should be able to measure objects with a radius smaller than the Moon. If we find transits, PEPSI@LBT (which is starting to work this year) and ESPRESSO@VLT (available in 2 years from now) will be able to measure the star's RVs in order to obtain also masses and densities of these extremely hot and peculiar planetary remnants.

The secondary goal of this proposal is to detect photometric variations due to reflection effects by BDs or faint stellar companions, ellipsoidal deformations, Doppler boosting. Kepler has already given an important contribution to this field. K2 can increase by a factor 5 to 10 the statistics of well studied sdB+WD and sdB+M-dwarf systems. We point out that the secondary goal is compatible with LC data.